Passerine extrapair mating dynamics

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Appendix C from J. E. Brommer et al., "Passerine Extrapair Mating Dynamics: A Bayesian Modeling Approach Comparing Four Species" (Am. Nat., vol. 176, no. 2, p. 178)

Evaluation of the Bayesian Model

We evaluated the accuracy of the fitting procedure by using simulated data. The procedure was primarily meant to give some indication of how credible intervals of the parameter estimates depended on sample size and to investigate whether there was any bias in the estimates.

Data were generated for three combinations of the parameters m (average EPCs per female) and s (within-brood EPF after a single EPC): $m = 0.5$ and $s = 0.5$ (low m, high s), $m = 1.4$ and $s = 0.5$ (high m, high s), and $m = 1.2$ and $s = 0.2$ (high m, low s). These combinations were chosen on the basis of the range of values estimated by Brommer et al. (2007). In order to evaluate whether brood size had an effect on the accuracy of the model, we generated data for brood sizes of 5 and 10. One data set was simulated for each parameter combination, for a total set of 250 broods. The model was fitted to subsets of the first 50, 100, 150, and 200 broods and to the full series of 250 broods.

Model evaluation. Fitting of the simulated data showed that our model is able to capture variation in parameters m and s to a satisfactory degree (fig. C1). That is, the 95% credible intervals of the parameters included the simulated value of the parameter (indicated by dotted line in fig. C1) in all but one case (fig. C1*B*). This is acceptable, because each parameter was fitted 30 times with a 95% credible interval, where one would thus expect the true estimate to fall outside the confidence range in one out of 20 fits.

The accuracy of parameter estimates and their credible intervals showed signs of a considerable improvement when sample sizes were higher. Even with 150 broods, the accuracy of both m and s was sometimes low (fig. C1*B*, C1*D*).

We assessed bias by testing whether, for any combinations of parameters m and s, deviations were consistently positive or negative across all five sample sizes. There was no evidence of bias (sign test: $P > .15$ for all parameter combinations). Credible intervals of the parameter s in particular were narrower for the large brood size (10) than for the small brood size (5; fig. C1*B*). Hence, precision of the estimates depend, to some extent, on the average brood size.

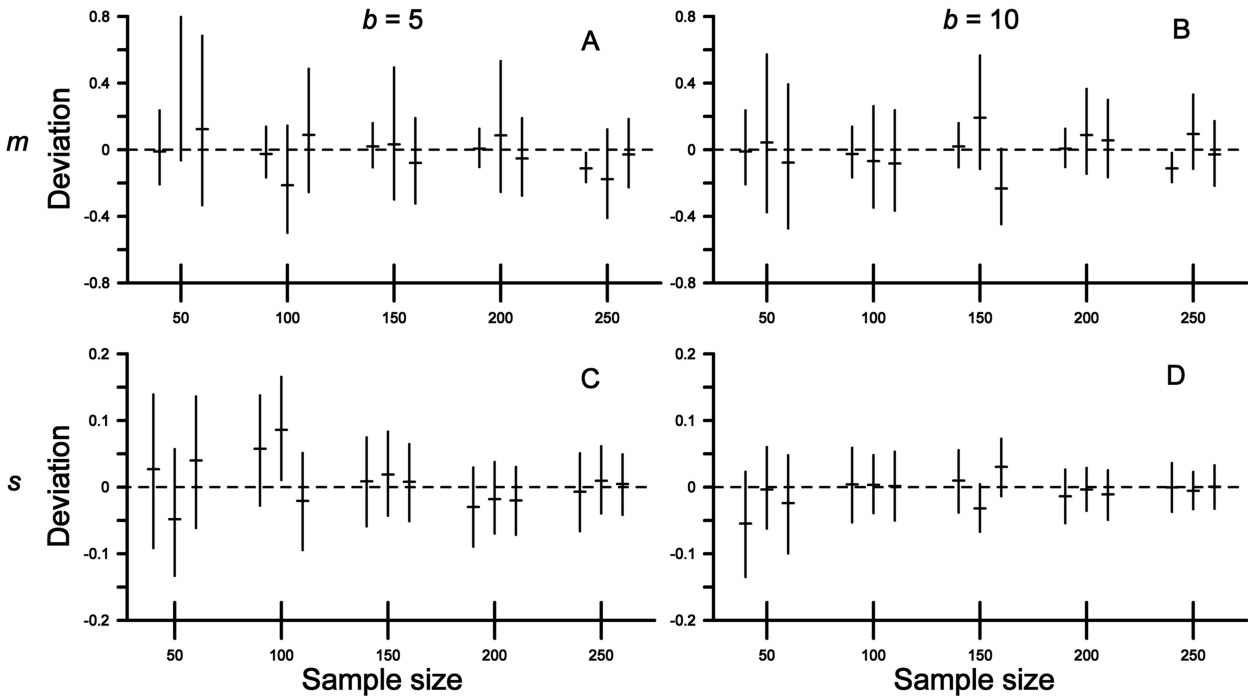

Figure C1: Deviation between estimated and real parameter value for various sample sizes, based on one random draw of simulated data of extrapair young with specified m and s. For samples of 50, 100, 150, 200, and 250, the mean difference between the estimated and the real parameter and its 95% highest posterior density are presented for each sample size in triplets that present $m = 0.5$ and $s = 0.5$ (*left*), $m = 1.2$ and $s = 0.2$ (*middle*), and $m = 1.4$ and $s = 0.5$ (*right*). Deviations of m and s are plotted for brood sizes of 5 (*A*, *C*) and 10 (*B*, *D*). Note that the range for one estimate in *A* (sample size 50, *middle bar*) falls outside the plotted scale (mean deviance 1.03, range $[-0.067, 3.235]$).